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A pilot secondary analysis of culture and gender differences in sustainability competencies among Indian and Omani high school students in English classrooms

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Research Article

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Abstract

Education for Sustainable Development (ESD) seeks to build competencies such as critical thinking, collaboration, and self-awareness, yet English language classrooms, where debate, group work, and intercultural contact are routine, are rarely studied as sites for them. This pilot secondary analysis examined whether such competencies, as reported by English learners, differ by culture and gender. Grade 11–12 students in Indian-curriculum and Omani private schools in Muscat, Oman, completed a 20-item survey on cultural effects in language learning, whose items were mapped onto UNESCO's key competencies for sustainability. After excluding 189 Omani records submitted as one rapid, near-identical batch, 314 students remained. Factor analysis identified four factors (critical thinking and participation, collaboration and achievement, self-regulation, and learner autonomy), but only the first was reliable ($\alpha = 0.72$) and hold-out confirmatory fit was inadequate (CFI = 0.83). The two groups reported similar critical thinking and participation, but Indian-curriculum students scored much higher on collaboration and achievement ($d = 1.10$), contrary to cultural-dimension expectations. Gender differences were small, consistent across groups, and showed no Culture × Gender interaction after correction; Bayes factors favored no interaction for 17 of 20 items. Left unscreened, the batch records produced spurious interactions on seven items and one scale. Culture appears to shape the collaborative rather than the critical dimension of sustainability competencies in English classrooms. The findings support gender-equitable ESD aligned with SDGs 4 and 5 and indicate that a purpose-built instrument and controlled data collection are needed for a main study.

Introduction

The 2030 Agenda for Sustainable Development commits countries to ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including through global citizenship and appreciation of cultural diversity (SDG target 4.7), and to eliminate gender disparities in education (SDGs 4.5 and 5) [1]. Education for Sustainable Development (ESD) translates this commitment into learning goals. UNESCO [2] identifies eight cross-cutting key competencies, among them critical thinking, collaboration, and self-awareness, and argues that they are developed through participatory, learner-centered methods rather than through content alone.

Those methods are already central to communicative English language teaching. Debates, critical discussion, role-plays, group projects, and contact with other cultures are everyday activities in English classrooms, and recent work has begun to examine how English courses and materials can carry sustainability themes and competencies [3, 4]. Most of this work, however, analyzes curricula, textbooks, or teacher perspectives. Much less is known about learners: how ready they report being for the practices through which these competencies develop, and whether this readiness differs between groups of students.

Two group differences matter particularly for ESD. The first is gender. Studies of sustainability consciousness often find that girls score higher than boys [5], whereas research on learning preferences

more broadly finds that most gender differences are small [6, 7]. If ESD competencies differ by gender, SDG 5 implies that teaching should address the gap; if they do not, gendered assumptions about who is suited to debate or cooperation should be avoided. The second is culture. Cultural-dimension theory predicts that learners from more collectivist societies will favor group harmony and cooperation, and those from less hierarchical societies critical debate [8, 9]. Such predictions are rarely tested against learners who share an educational setting, and they risk stereotyping students by nationality [10].

Oman offers an unusual opportunity to test both. Indian-curriculum schools serving the large Indian community and Omani private schools operate side by side in Muscat under the oversight of the same Ministry of Education. Their students learn English in the same city and the same broader society, but come from different cultural, linguistic, and educational traditions. Comparing them removes many of the confounds that complicate cross-national comparisons, such as differences in national curricula, language environments, and survey administration. A design that crosses culture with gender also allows a direct test of whether gender differences depend on culture, which appears statistically as a Culture × Gender interaction.

Group comparisons based on online surveys are, however, vulnerable to artifacts. Groups differ in response style, such as a general tendency to agree, which can make one group appear higher on every scale [11, 12], and online forms can contain duplicate or careless submissions that manufacture group differences [13, 14]. A credible comparison has to check for both.

This pilot secondary analysis re-reads a 20-item survey on the effect of culture on English language learning as a set of indicators of UNESCO's sustainability competencies. Because the survey was not designed for this purpose, the study is framed as a pilot: it asks whether the approach is workable and what a main study would need, as well as what the data show. Three research questions are addressed:

1. **RQ1 (Competencies and culture)**: To what extent do Indian and Omani English learners report sustainability-related competencies, and do the two groups differ?
2. **RQ2 (Competencies and gender)**: Do these competencies differ by gender, and is the gender pattern the same in both cultural groups?
3. **RQ3 (Feasibility and measurement)**: How complete and independent are the responses, how well do the items measure the intended competencies, and what must change for a main study?

Literature review

Key competencies for sustainability

Research on ESD has moved from what learners should know about sustainability to what they should be able to do. Wiek et al. [15] proposed a reference framework of key competencies (systems thinking, anticipatory, normative, strategic, and interpersonal competence), and UNESCO [2] extended it to eight cross-cutting competencies that apply across all SDGs: systems thinking, anticipatory, normative, strategic, collaboration, critical thinking, self-awareness, and integrated problem-solving. The European

GreenComp framework similarly includes critical thinking, collective action, and individual initiative [16]. Three features of these frameworks matter here. Several competencies are generic rather than environmental: critical thinking means questioning norms and taking a position, collaboration means learning from and working with others, and self-awareness means reflecting on and regulating one's own actions [2]. Competencies combine cognitive, socio-emotional, and behavioral elements, so learners' dispositions toward participatory practices are part of what is to be developed. And they are expected to grow through participatory methods across subjects, not only in science or geography.

Measurement has lagged behind these frameworks. The most widely used school-level instrument, the Sustainability Consciousness Questionnaire, measures knowledge, attitudes, and behavior across environmental, social, and economic dimensions rather than the key competencies themselves [17]. Measures of collaboration or critical thinking as sustainability competencies, especially for secondary learners outside Europe, remain scarce.

The English classroom as a site for ESD

Communicative and task-based English teaching relies on the participatory methods that UNESCO [2] recommends: discussion, debate, role-play, group work, and engagement with other cultures. Recent studies have begun to make this link explicit. Content analysis of a widely used EFL textbook found that most SDGs were represented and that particular grammar and skills exercises could support sustainability competencies [3], and conceptual work has argued that EFL oral communication can foster competencies through collaboration, cooperation, and inclusive interaction [4]. This literature focuses on materials, curricula, and teaching. Learners' own reported readiness for these practices, and how it varies across groups, has received little attention.

Gender

Two literatures point in different directions. In sustainability education, girls often score higher than boys. In a nationwide Swedish study, girls scored higher on sustainability consciousness, the gap widened with age, and it was larger in ESD-certified schools [5]. In research on learning styles and preferences, by contrast, gender differences are usually small and inconsistent [18], in line with the gender similarities hypothesis that most psychological gender differences are small [6, 7]. Gulf studies add a contextual layer: in Oman, female students have been found to prefer collaborative learning more than males while sharing other preferences [19]. Whether gender differences in ESD-relevant competencies are large or small, and whether they are the same across cultural groups, is therefore an open question with direct relevance to SDG 5.

Culture and learning

Cultural-dimension theory links national values to learning preferences. Societies scoring low on individualism are expected to favor cooperation and group harmony, and those high on power distance to favor teacher authority over learner debate [8]. Studies of management students have found that cultural values predict learning preferences [9]. On Hofstede's indices, Arab countries score lower on individualism than India, which would predict stronger collaborative preferences among Omani than Indian students. Two cautions apply. Nationality is a coarse proxy for culture, and attributing classroom behavior to national culture risks stereotyping learners [10]. And most comparisons are made across countries, where culture is confounded with curriculum, school system, and language environment. Comparing groups that share one city and one Ministry offers a cleaner test.

Survey artifacts in group comparisons

Cross-group survey comparisons face two well-documented threats. Groups differ in response style: acquiescent and extreme responding vary across cultures [12], so one group can appear higher on every scale, and within-person standardization is a standard correction [11]. Online surveys can also contain careless, duplicate, or bulk submissions [13, 14]. If such records are concentrated in one group, they reduce the effective sample size and can create group differences and interactions that do not exist among real respondents. Neither threat is routinely checked in ESD or language-learning surveys.

Materials and methods

Design and participants

The study used a cross-sectional 2 (culture: Indian, Omani) × 2 (gender: female, male) between-subjects survey design. Participants were Grade 11 and 12 students enrolled in English courses in Indian-curriculum schools and Omani private schools in Muscat. Participating schools were assigned by the Ministry of Education, Sultanate of Oman, which distributed an online survey link that students completed in class between 30 December 2021 and 22 May 2022. The form recorded gender, grade, and group (Indian student from an Indian school; Omani student from a private school), but not school. All data were collected in Oman; "India" refers to Indian students attending Indian-curriculum schools in Oman. The same data collection included the Learning Style Survey, whose results are reported in a separate manuscript that is currently under review (Nassim S, "Gender similarities in language learning preferences among Indian and Omani school students in Oman: implications for gender-equitable education and sustainable development", under review); the two instruments were completed on separate forms that cannot be linked at the student level, and no results from that survey are reported here.

Table 1
Records received, exclusions, and analytic samples.

Sample	India F	India M	Oman F	Oman M	Total
Records received	168	86	86	164	504
Excluded: batch-entry window	0	0	57	132	189
Excluded: identical answer to all 20 items	1	0	0	0	1
Primary analytic sample	167	86	29	32	314
Sensitivity sample: near-duplicate clusters, earliest kept	166	86	37	41	330

A second straight-lined record fell inside the batch window. Grade 11/12 in the primary sample: India 179/74, Oman 41/20.

Instrument and competency mapping

The questionnaire contains 20 statements about English learning preferences rated Never (0), Rarely (1), Sometimes (2), Often (3), or Always (4). Items 5 and 20 are negatively worded. It was developed by the researchers as a survey to analyze the effect of culture on language learning, not to measure sustainability competencies, and it had no scoring key. The items are reproduced as administered in Appendix A. For this study, scales were derived empirically by factor analysis and then mapped to the closest UNESCO [2] competency or SDG target (Table 2). The mapping is interpretive; whether the items cohere as intended is tested in the Results.

Table 2
Mapping of questionnaire items to sustainability competencies.

Competency (framework)	Items	Scoring
Critical thinking & participation (UNESCO critical thinking)	1 debates on current topics; 2 critical discussions; 8 role-plays and skits; 9 leading group activities; 16 group activities	Mean of 5 items
Collaboration & achievement (UNESCO collaboration)	10 cooperating with group members; 17 obeying group norms; 11 always scoring high marks	Mean of 3 items
Self-regulation (UNESCO self-awareness)	4 doing activities on time; 5 not minding missed deadlines (reversed); 19 anxiety at a missed deadline	Mean of 3 items
Learner autonomy (UNESCO self-awareness)	15 individual over group achievement; 18 learning English by myself	Mean of 2 items
Intercultural openness (SDG 4.7)	13 not minding mixing my culture with others'	Single item
Not mapped	3 English for jobs; 6 reading stories and novels; 7 English movies; 12 being appreciated; 14 technology; 20 disliking exams	Single items

Item 11 loaded with the collaboration items but concerns achievement, so that scale is labeled collaboration & achievement. No item measures systems thinking, anticipatory, normative, or strategic competence.

Data screening

Answers were coded 0–4 after correcting inconsistent capitalization (147 answers); there were no missing data. Each record was compared with every other record on all 20 items, and submission times were inspected.

Inspection revealed a batch-entry window. Between 21:16 on 29 January and 15:13 on 30 January 2022, 189 Omani records arrived one at a time at a median interval of 1.03 min (interquartile range 0.93–1.25), too fast for independent completion of a 20-item form. The median record in this window differed from the one before it on 3 items, against 13 for other Omani records, and the mean between-respondent item SD was 0.44, against 1.01 for other Omani and 1.08 for Indian records. Gender codes switched between consecutive near-identical records. All 189 records were excluded. Records giving the same answer to all 20 items were also excluded. These two rules defined the primary sample (N = 314).

Two sensitivity samples tested the screening decisions. The first applied a similarity rule: records differing on 2 or fewer items (10%) from another record were linked into clusters and the earliest record of each cluster retained (N = 330). A shuffled-data baseline, permuting each item independently within group, showed that such matches arise by chance for about 7% of Omani and no Indian records, so this rule is conservative. The second additionally excluded 18 Omani records from a shorter run on 20 January 2022 (09:20–10:00) that showed a weaker version of the same pattern (N = 296).

Analysis

Structure. Factorability was checked with the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test. The number of factors was chosen by parallel analysis (500 random data sets, 95th percentile eigenvalues). Exploratory factor analysis (EFA) used minimum residual extraction with oblimin rotation. Items whose highest loading was at least 0.30 without cross-loading formed scales, scored as item means on the 0–4 metric with item 5 reversed. To check the structure on data not used to derive it, the sample was randomly split, and the four-factor model was tested by confirmatory factor analysis (CFA) on the hold-out half (n = 157).

Reliability. Cronbach's α with 95% confidence intervals and McDonald's ω (for scales of three or more items) were computed overall, and α by group.

Group effects. For each competency and each item, a two-way analysis of variance (ANOVA) with Type III sums of squares and sum-to-zero contrasts tested culture, gender, and their interaction, with partial η^2 ($\eta^2 p$). The Benjamini–Hochberg false discovery rate correction [20] was applied within each family of tests (4 scales; 20 items). Cohen's d with 95% confidence intervals was computed for gender within each group (female minus male) and for culture (Oman minus India). Multivariate analysis of variance (MANOVA) on the 20 items gave omnibus tests.

Evidence for no interaction. Because a non-significant interaction is not evidence of absence, Bayes factors (BF_{01}) comparing the main-effects model with the interaction model were computed from the Bayesian information criterion [21]. Values above 3 and 10 indicate moderate and strong evidence for no interaction.

Response style and robustness. An acquiescence index was computed as each respondent's mean rating across all items, and all analyses were repeated on within-person standardized (ipsatized) scores, obtained by subtracting each respondent's mean rating from each item [11]. Further checks used heteroscedasticity-consistent (HC3) standard errors, grade as a covariate, the two sensitivity samples, and all 504 records.

Analyses were run in Python 3.12 with pandas, statsmodels, SciPy, pingouin, factor_analyzer, and semopy. The script reproduces every table and figure and is provided as Supplementary Information.

Use of generative AI. Claude Opus 5.5 (Anthropic; accessed via claude.ai, 2026) was used to write and run the analysis code, prepare tables and figures, search for and check references, and draft and edit the manuscript text. The authors reviewed and verified all analyses, results, references, and text, and take full responsibility for the content of this article. [Edit to reflect the final extent of AI use.]

Results

Data quality and screening (RQ3)

The batch-entry records differed sharply from other submissions (Fig. 1): they arrived about one minute apart and usually changed only a few answers from the previous record, whereas other Omani records were spaced irregularly and differed on most items. A shorter run on 20 January 2022 showed a weaker form of the same pattern, which the second sensitivity sample addresses.

Screening changed the substantive results (Table 3). In all 504 records, seven items and the Self-regulation scale showed a Culture × Gender interaction that survived correction; in the screened sample, none did. The batch records also inflated the culture effect, more than doubling the multivariate effect size.

Table 3
Key results in all records and in the screened sample.

Result	All records (N = 504)	Screened (N = 314)
Culture × Gender interactions significant after correction	7 items + Self-regulation	None
MANOVA interaction, Pillai's V	0.121, $F(20, 481) = 3.32$, $p < 0.001$	0.097, $F(20, 291) = 1.56$, $p = 0.063$
MANOVA culture effect, Pillai's V	0.613	0.259
Culture difference on item 10 (cooperation), d	−2.12	−1.09
Gender difference in Oman on Self-regulation, d	−0.88	−0.18

The batch window held 132 of the 164 Omani male records, so screening also changed the composition of the Omani sample, leaving 61 Omani students.

Structure and reliability of the competency measures (RQ3)

The screened data were factorable (KMO = 0.71; Bartlett $\chi^2 = 1097.5$, $p < 0.001$), although items 3, 15, 18 and 20 had low individual KMO values (0.52–0.56). Parallel analysis supported three factors clearly (observed eigenvalues 3.45, 1.90 and 1.59 against random 1.56, 1.45 and 1.38) and a fourth marginally (1.33 against 1.31). The four-factor solution explained 27% of the variance and matched the intended competencies in part: debate, discussion, role-play and leadership items formed one factor; cooperation, group norms and high marks a second; the deadline items a third; and the two individual-learning items a fourth. Factor correlations were at most 0.25. Items 3, 6, 7, 13, 14 and 20 loaded on no factor, and item 12 cross-loaded.

The structure did not hold up well on the hold-out half. CFA of the four-factor model showed inadequate fit ($n = 157$; $\chi^2(59) = 121.19$, $p < 0.001$; CFI = 0.83; TLI = 0.77; RMSEA = 0.082), and fit in the full sample was similar (CFI = 0.81; RMSEA = 0.087).

Table 4
Reliability of the competency scales.

Competency	Items	α [95% CI]	ω	α India	α Oman	Lowest item–rest r
Critical thinking & participation	5	0.72 [0.67, 0.77]	0.74	0.74	0.65	0.38
Collaboration & achievement	3	0.62 [0.54, 0.69]	0.63	0.48	0.71	0.39
Self-regulation	3	0.56 [0.46, 0.64]	0.57	0.56	0.53	0.32
Learner autonomy	2	0.35 [0.19, 0.48]	—	0.42	−0.09	0.21

Only Critical thinking & participation reached conventional reliability. Learner autonomy was unreliable, especially in Oman, and is interpreted cautiously below. The competencies were weakly related: Collaboration & achievement correlated 0.28 with Critical thinking & participation and 0.27 with Self-regulation, intercultural openness correlated about 0.2 with both, and Learner autonomy was unrelated to the others (r between − 0.10 and 0.05).

Competency profiles by culture and gender

Figure 2 and Table 5 show the competency scores. All groups reported collaboration & achievement most strongly (means 2.80–3.59 on the 0–4 scale) and critical thinking & participation least strongly (1.96–2.22), that is, around “sometimes.”

Table 5
Competency means (SD) and two-way ANOVA results.

Competency	India F (n = 167)	India M (n = 86)	Oman F (n = 29)	Oman M (n = 32)	Culture F, η^2p	Gender F, η^2p	C × G F, p	BF_{01}
Critical thinking & participation	2.22 (0.84)	2.07 (0.76)	2.16 (0.62)	1.96 (0.67)	0.53, 0.002	2.29, 0.007	0.05, 0.829	17.3
Collaboration & achievement	3.59 (0.50)	3.38 (0.53)	3.00 (0.63)	2.80 (0.85)	51.93*, 0.143	6.44*, 0.020	0.01, 0.917	17.6
Self-regulation	2.95 (0.75)	2.68 (0.79)	2.61 (0.64)	2.74 (0.79)	1.64, 0.005	0.42, 0.001	3.40, 0.066	3.2
Learner autonomy	2.53 (0.81)	2.58 (0.92)	2.43 (0.66)	2.25 (0.66)	3.22, 0.010	0.32, 0.001	0.96, 0.329	10.9
Intercultural openness (item 13)	3.01 (1.12)	2.67 (1.31)	2.69 (1.00)	2.19 (0.97)	5.94*, 0.019	6.40*, 0.020	0.25, 0.620	15.6

All F tests df = 1, 310. * Significant after Benjamini–Hochberg correction (scales within the family of 4 scales; item 13 within the family of 20 items).

Competencies and culture (RQ1)

The two groups did not differ in critical thinking & participation (d = − 0.14, 95% CI − 0.42 to 0.14), self-regulation or learner autonomy. They differed strongly in collaboration & achievement, which Indian-curriculum students endorsed more (d = − 1.10, 95% CI − 1.39 to − 0.80; η^2p = 0.143), and moderately in intercultural openness (d = − 0.41, 95% CI − 0.69 to − 0.12). At item level, nine items differed after correction (Table 6).

Table 6
Items differing between Indian and Omani students after correction.

Item	Competency	India M	Oman M	d (Oman − India)	Adjusted p
10 Cooperating with group members	Collaboration	3.61	2.77	−1.09	< 0.001
17 Obeying group norms	Collaboration	3.36	2.66	−0.80	< 0.001
6 Reading English stories and novels	Not mapped	2.66	2.03	−0.52	0.017
11 Always scoring high marks	Achievement	3.60	3.26	−0.49	0.017
12 Being appreciated	Not mapped	3.02	2.56	−0.44	0.017
9 Leading group activities	Critical thinking & participation	2.37	1.92	−0.41	0.018
13 Mixing my culture with others'	Intercultural openness	2.90	2.43	−0.41	0.034
18 Learning English by myself	Learner autonomy	2.92	2.54	−0.38	0.023
20 Disliking English exams	Not mapped	1.09	1.62	+ 0.43	0.019

Part of this pattern reflects response style. Indian students agreed more with statements in general (acquiescence index: India female 2.61, male 2.52; Oman female 2.47, male 2.27; culture F(1, 310) = 13.27, p < 0.001, η^2p = 0.041). After within-person standardization, Collaboration & achievement still differed (η^2p = 0.083, d = − 0.80), as did cooperation (item 10), group norms (item 17) and exam dislike (item 20); debate (item 1) became relatively higher among Omani students (d = 0.45), and intercultural openness no longer differed. The multivariate culture effect was significant in raw (Pillai's V = 0.259, F(20, 291) = 5.08, p < 0.001) and standardized scores (V = 0.212, F(19, 292) = 4.15, p < 0.001).

Competencies and gender (RQ2)

No Culture × Gender interaction survived correction on any competency or item (smallest adjusted p = 0.18), and the multivariate interaction was not significant (V = 0.097, F(20, 291) = 1.56, p = 0.063). Bayes factors favored the model without an interaction for all four scales and for 17 of 20 items, with strong evidence (BF_{01} > 10) for Critical thinking & participation, Collaboration & achievement and Learner autonomy. The weakest case was Self-regulation (BF_{01} = 3.2), on which Indian girls scored higher than Indian boys (d = 0.36) while Omani boys scored slightly higher than Omani girls (d = − 0.18).

Gender differences were small to moderate and, where significant, ran in the same direction in both groups (Fig. 3). Female students scored higher on Collaboration & achievement (d = 0.42 in India, 0.26 in Oman; η^2p = 0.020) and intercultural openness (d = 0.29, 0.51; η^2p = 0.020), but not on Critical thinking & participation (d = 0.18, 0.31; η^2p = 0.007). Within-group values are reported because girls were over-represented in the Indian group. Five items differed after correction: reading English fiction (d = 0.76 India, 0.50 Oman), scoring high marks (0.38, 0.48), mixing cultures (0.29, 0.51), debate (0.16, 0.68) and critical discussion (0.10, 0.81). The last two differences were concentrated in Oman, but the interaction tests for these items were not significant after correction.

Much of the gender pattern reflected general endorsement. Female students had higher acquiescence scores (F(1, 310) = 7.08, p = 0.008, η^2p = 0.022), and after standardization only reading English fiction still differed (d = 0.66). The multivariate gender effect was significant in raw (V = 0.113, F(20, 291) = 1.86, p = 0.015) and standardized scores (V = 0.099, F(19, 292) = 1.68, p = 0.039).

Robustness

The central conclusions held across all checks. With HC3 standard errors and with grade as a covariate, no interaction survived correction (smallest adjusted p ≥ 0.18). Excluding the second fast-entry run (N = 296) left no interaction (smallest adjusted p = 0.12), the culture difference on Collaboration & achievement, and the same five gender items. In the near-duplicate cluster sample (N = 330), which retains some batch-window records, the only interaction approaching significance was Self-regulation (adjusted p = 0.050, BF_{01} = 0.77), the same scale that had the weakest evidence above. The culture difference on Collaboration & achievement, and the gender difference on reading English fiction, appeared in every analysis.

Discussion

This pilot asked whether English learners' reported readiness for sustainability-related practices differs by culture and gender. Three findings stand out. Culture was associated with the collaborative dimension, not the critical one. Gender differences were small and consistent across the two groups. And data screening and measurement quality determined what could be concluded at all.

Culture shapes collaboration more than critical thinking

Indian-curriculum and Omani students reported the same, moderate readiness for debate, discussion, role-play, and leadership, the practices most closely linked to UNESCO's critical thinking competency. They differed strongly in collaboration & achievement, and the difference survived correction for response style. Its direction contradicts cultural-dimension expectations: on Hofstede's indices Arab societies are less individualist than India, which predicts stronger collaborative preferences among Omani students [8]. The opposite was observed.

The most plausible explanation is school culture rather than national values. Collaboration & achievement combines cooperation, adherence to group norms, and striving for high marks, a combination that fits structured, examination-oriented classrooms where group work is routine and performance is closely monitored. The scale's higher reliability among Omani than Indian students also suggests that the items may not mean quite the same thing in the two groups. Either way, the result shows that nationality is a poor guide to learners' collaborative dispositions, which supports critiques of cultural stereotyping in language teaching [10] and argues against designing ESD activities around assumed national traits.

The absence of a difference in critical thinking & participation is equally informative. Both groups reported this competency least strongly, around "sometimes." For ESD this is the more pressing finding: the practices through which learners learn to question norms and take a position appear to be the least familiar to students in both school systems, and they are the ones an English classroom is particularly well placed to provide [4]. This matches evidence from Omani higher education that students make limited progress in demonstrating critical thinking in English academic writing [22], and that speaking anxiety restricts Omani learners' participation in oral tasks unless low-pressure practice opportunities are provided [23].

Gender: similar competencies across cultures

The gender pattern supports a similarities account [6, 7]. Differences were small to moderate, ran the same way in both groups, and showed no reliable interaction, and Bayes factors gave strong evidence against an interaction for the critical thinking and collaboration scales. Female students reported somewhat more collaboration and intercultural openness, consistent with research showing higher sustainability consciousness among girls [5] and stronger collaborative preferences among Omani female students [19]. Similarly, a longitudinal study of Omani undergraduates found minimal gender differences in critical thinking performance in English writing [22]. Most of these differences shrank once general endorsement was removed, so they partly reflect how strongly girls agree with learning-related statements rather than distinct competency profiles.

Two patterns deserve attention in a larger study. Omani female students reported markedly more readiness for debate and critical discussion than Omani males ($d = 0.68$ and 0.81), a contrast not seen in the Indian group. If confirmed, this would challenge assumptions that Gulf female students are less ready to take a position in class. And self-regulation was the one competency on which the evidence

against an interaction was weak, with opposite gender patterns in the two groups. With only 61 Omani students, neither pattern can be established here.

Intercultural openness and SDG 4.7

Indian-curriculum students and female students were more willing to mix their own culture with others', but the culture difference disappeared after standardization and rests on a single item. In a country whose schools serve both national and large expatriate communities, intercultural openness is an obvious target for SDG 4.7 work in English classrooms. It needs a proper multi-item measure before group differences can be interpreted.

Methodological lessons

Two methodological findings matter beyond this study. First, 38% of submissions had to be excluded, and the excluded records were not random: they came from one group, at one time, with near-identical answers. Left in, they produced interactions and inflated culture effects that would have led to the opposite conclusion about gender and culture. School-based online surveys distributed through ministries or teachers may be especially vulnerable to bulk entry, and simple checks of submission timing and response similarity should be routine in ESD survey research.

Second, re-reading an existing survey as a competency measure was only partly successful. The exploratory structure matched the intended competencies in outline, but the confirmatory test on hold-out data showed inadequate fit, and only one scale was reliable. This is useful pilot evidence: it shows which items carry the critical thinking and collaboration constructs well enough to keep, and it shows that self-awareness, intercultural openness, and the competencies not covered at all, such as systems thinking, need purpose-built items.

Implications for teaching

Three practical implications follow, with the caution appropriate to a pilot. Teachers should not assume that one cultural group is more collaborative or more critical than another; in this sample, the expected pattern was reversed. Critical discussion and debate deserve more space in English lessons for all students, since both groups reported them least. These competencies also matter beyond school: Omani university students identified communication and critical thinking as their most developed skills, and perceived curriculum relevance predicted their career readiness [24]. And because gender differences were small and similar across cultures, ESD-oriented English teaching should offer the same participatory opportunities to girls and boys rather than steering either toward particular roles, consistent with SDG 5.

Limitations and future directions

The study has five main limitations. First, the survey was not designed to measure sustainability competencies; the mapping to UNESCO [2] is interpretive, the confirmatory fit was inadequate, and only

one scale was reliable, so low reliability attenuates effects and limits comparisons. Second, after screening the Omani sample was small (29 female, 32 male), which makes Omani estimates imprecise and limits the power to detect interactions; the Bayes factors mitigate but do not remove this problem. Third, the exclusion rule rests on submission timing and response similarity, which strongly suggest bulk entry but cannot prove which records were genuine. Fourth, schools were assigned by the Ministry rather than sampled randomly, school membership was not recorded so clustering could not be modeled, and each group came from one school type, so the findings do not generalize to national populations or public schools. Fifth, all measures were self-reports of preferences, not observed competencies or learning outcomes.

A main study should therefore:

1. **Use a purpose-built competency instrument.** Write or adapt at least four items for each competency studied, including systems thinking and anticipatory thinking, with reverse-worded items in every scale. Separate cooperation from achievement, and turn intercultural openness into a multi-item scale linked to SDG 4.7.
2. **Keep what worked.** Retain items 1, 2, 8, and 9 for critical thinking & participation and items 10 and 17 for collaboration. Revise or drop items 3, 15, 18, and 20.
3. **Control data collection.** Use one-response-per-login settings and record a school code, an anonymous student code, and completion time. Pre-register the screening rules used here.
4. **Test measurement invariance** across culture and gender with multi-group CFA before comparing means [25].
5. **Size the sample.** Detecting an interaction of $f = 0.14$ with 80% power at $\alpha = 0.05$ requires about 400 students; aim for at least 100 genuine respondents per cell, recruit more Omani schools, and include public schools.
6. **Measure culture and outcomes directly.** Add individual-level cultural values rather than relying on nationality, and link self-reports to observed classroom collaboration and discussion or to English achievement.

Conclusion

Read as indicators of sustainability competencies, English learners' classroom preferences in two cultural communities in Oman showed a clear pattern. Students shared a moderate readiness for critical discussion but differed strongly in collaboration, in the opposite direction to cultural-dimension predictions, and girls and boys differed little and in the same way in both groups. These results suggest that the English classroom is a promising and under-used site for ESD, that national stereotypes are a poor guide to learners' sustainability-related dispositions, and that gender-equitable participatory teaching is consistent with the evidence. As a pilot, the study also shows what a main study needs: a purpose-built competency instrument and data collection designed to prevent the bulk submissions that, left unchecked, would have reversed its conclusions.

Declarations

Ethics approval

The secondary analysis reported here was reviewed by the Institutional Research Ethics and Intellectual Property Committee (REIC), Modern College of Business and Science, Muscat, Sultanate of Oman (Ref. No. RE/2026/001, 8 November 2026). The data were originally collected for the author's doctoral research at Banasthali Vidyapith, India, under the authorization of the Directorate General of Education, Muscat Governorate, Ministry of Education, Sultanate of Oman (letter No. 158, 15 November 2021), and the questionnaire was certified as designed for research purposes and free of unethical questions by the Head of the Department of English and Modern European Languages, Banasthali Vidyapith. The original data collection was not reviewed by an ethics committee.

The study was conducted in accordance with the relevant guidelines and regulations, including the regulations of the Ministry of Education, Sultanate of Oman, for research in schools and the ethical principles of the Declaration of Helsinki.

Consent to participate

Informed consent was obtained in implied form. Before completing the questionnaire, participants were informed of the purpose of the study and that participation was voluntary and anonymous, and submission of the completed online questionnaire was taken as implied informed consent. Written consent was not collected because the questionnaire was anonymous and recorded no names, contact details, or school identifiers. The questionnaire was administered in class under the authorization of the Ministry of Education, Sultanate of Oman, in accordance with the participating schools' established procedures, and the present secondary analysis of these anonymous data was reviewed by the REIC, Modern College of Business and Science (Ref. No. RE/2026/001).

Consent for publication

Not applicable. The article contains no individual person's data in any form.

Competing interests

The authors declare no competing interests.

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Figures

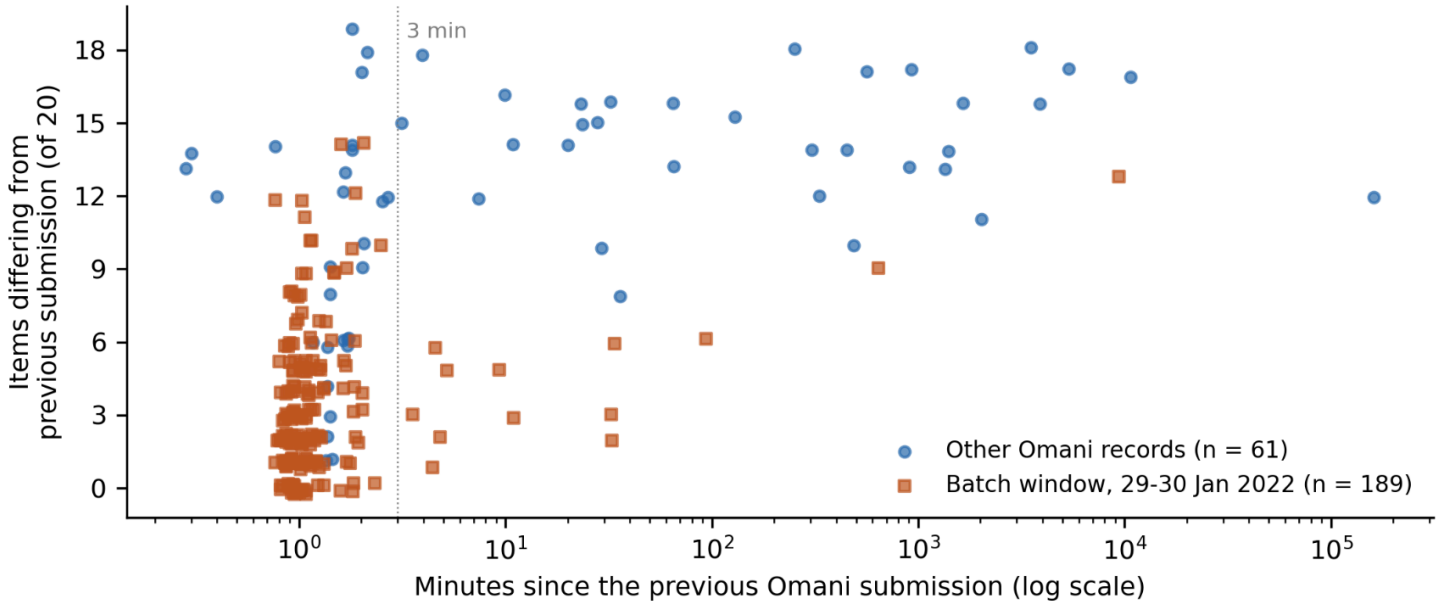

Figure 1

Screening signature of Omani submissions. Each point compares a record with the previous Omani record. Vertical jitter added.

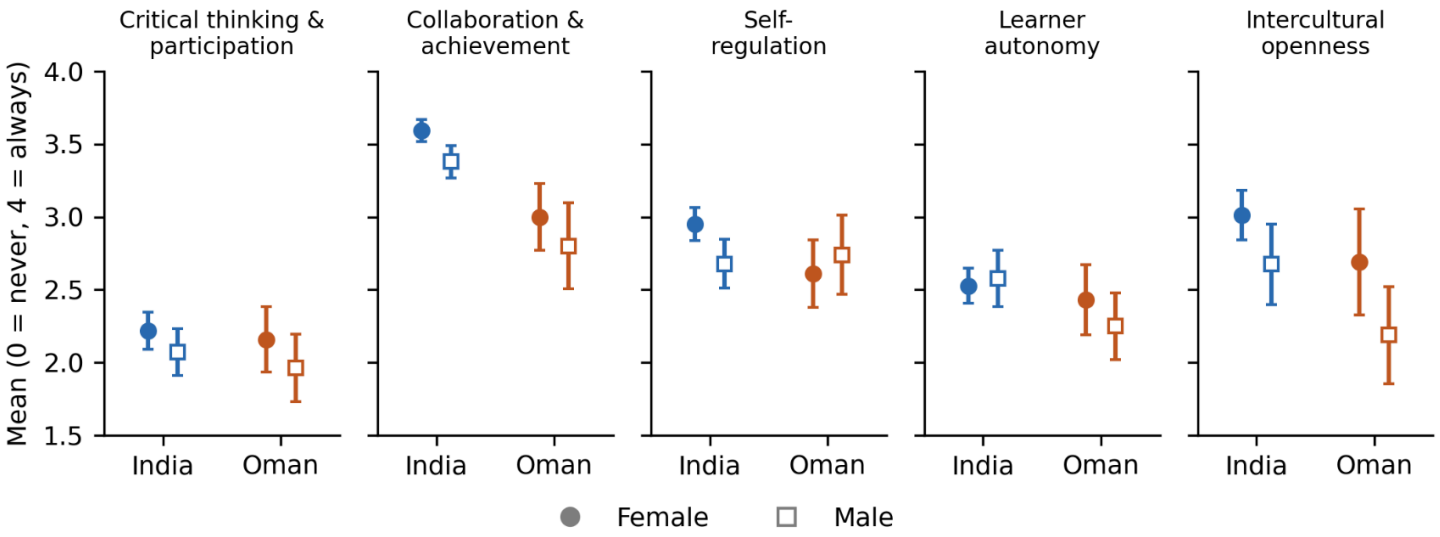

Figure 2

Competency means by culture and gender, with 95% confidence intervals. Filled circles, female; open squares, male. Intercultural openness is a single item.

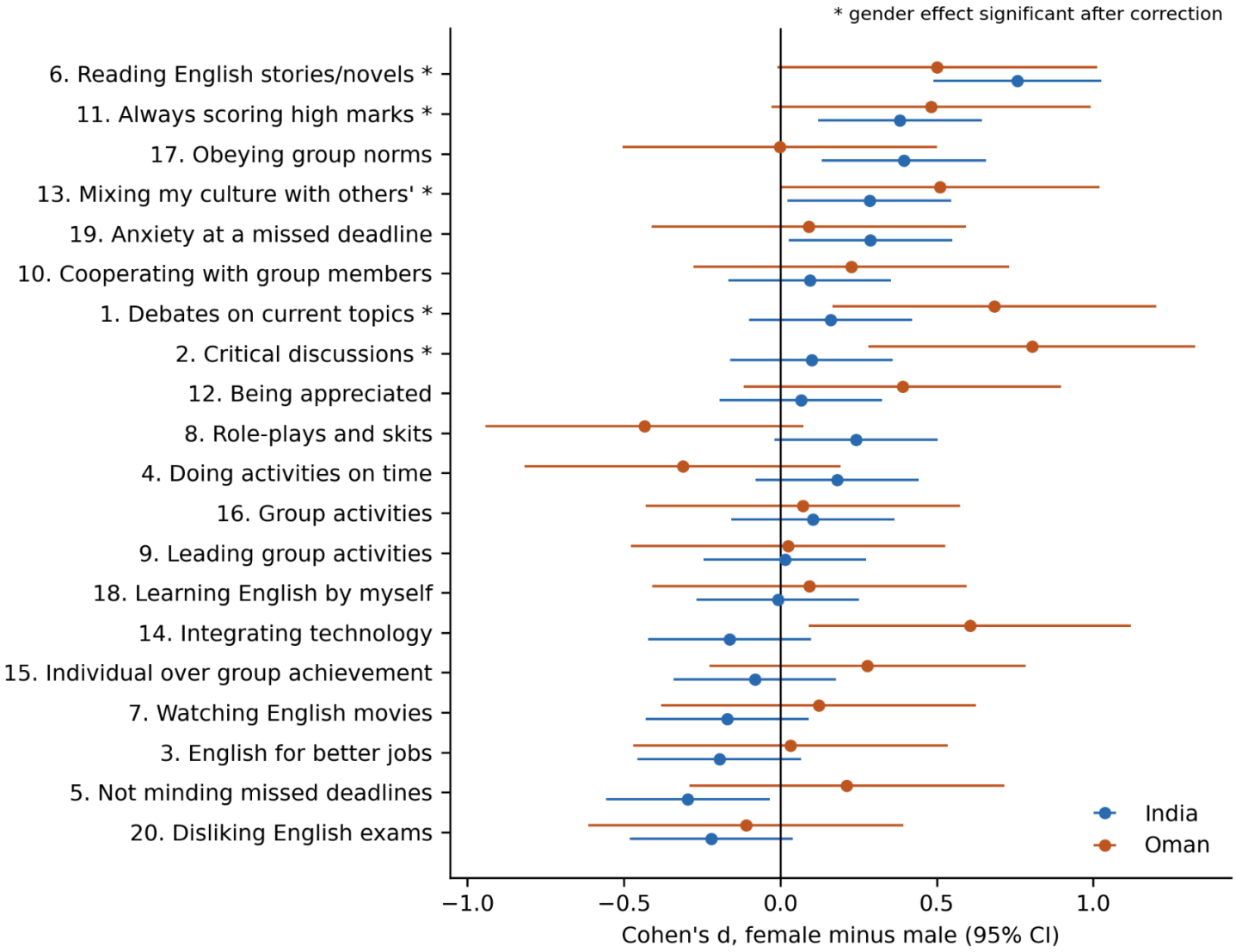

Figure 3

Gender differences (female minus male) for each item in each group, with 95% confidence intervals. Items ordered by the pooled difference.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- files5.zip
- AppendixA.docx